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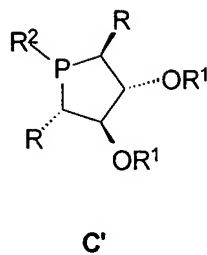
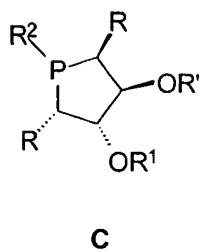
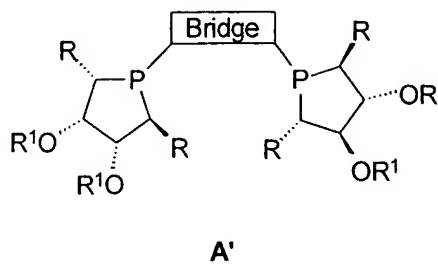
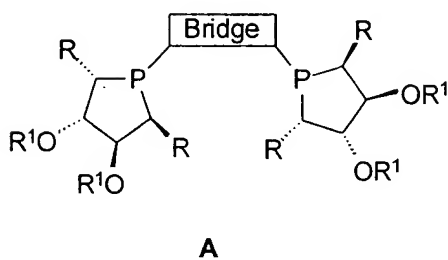
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**WHAT IS CLAIMED IS:**

1. A compound of formula A, A', C and C', or the corresponding enantiomer:



wherein:

- a) R and R<sup>2</sup> are independently aryl, alkyl, alkyl aryl, aryl alkyl, or chiral oxazolino which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, or diphenylphosphino groups;
- b) R<sup>1</sup> can be H, alkyl, silane, aryl, a water soluble unit, or a linked polymer chain or inorganic support; and

c) Bridge may be:

$-(CH_2)_n-$  where n is an integer ranging from 1 to 8;

$-(CH_2)_nX(CH_2)_m-$  wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S,  $NR^4$ ,  $PR^4$ ,  $AsR^4$ ,  $SbR^4$ , divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein  $R^4$  is aryl, alkyl, substituted aryl, or substituted alkyl; or 1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I,  $COOR^5$ ,  $SO_3R^5$ ,  $PO_3R^5_2$ ,  $OR^5$ ,  $SR^5$ ,  $NR^5_2$ ,  $PR^5_2$ ,  $AsR^5_2$ , or  $SbR^5_2$ ;

wherein the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, alkyl, alkoxyl, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acids; and

$R^5$  is hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, or C1-C8 perfluoroalkyl, aryl; substituted aryl; arylalkyl; ring-substituted arylalkyl; or –  $CR^3_2(CR^3_2)_qX(CR^3_2)_pR^1$  wherein q and p are integers, the same or different, ranging from 1 to 8;  $R^3$  is aryl, alkyl, substituted aryl, or substituted alkyl; and X is as defined above.

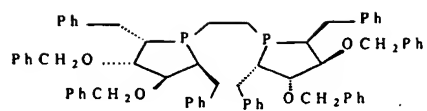
2. A compound according to claim 1, wherein the compound is of formula A or A', or the corresponding enantiomer.

3. A compound according to claim 2, wherein the compound is of formula A or A', or the corresponding enantiomer, wherein R is methyl, ethyl, or benzyl;  $R^1$  is hydrogen or benzyl; and Bridge is:

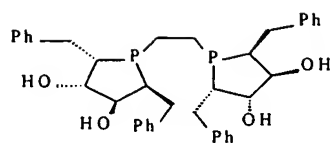
$-(CH_2)_n-$  where n is an integer ranging from 1 to 3;

1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl, 2,2'-divalent 1,2'-binaphthyl, or ferrocene, each of which may be substituted with alkyl having 1-3 carbon atoms or  $OR^5$ , wherein  $R^5$  is methyl or ethyl.

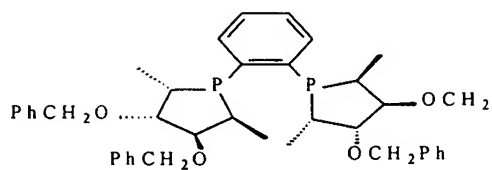
4. A compound according to claim 3, selected from L1, L3-L5, L7-L8, L10-L12, and L18-L21:



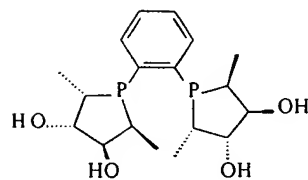
L 1 (A)



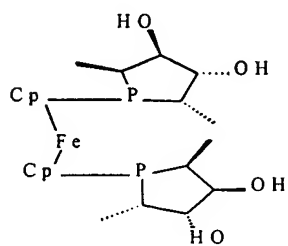
L 3 (A)



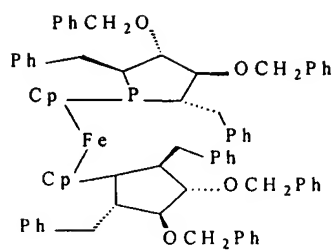
L 4 (A)



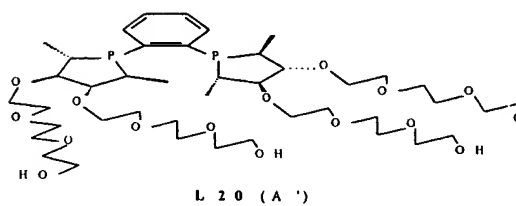
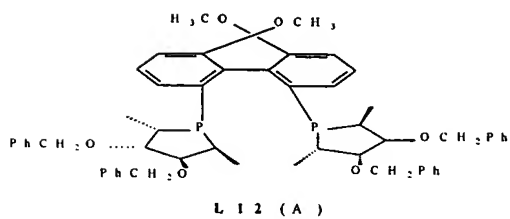
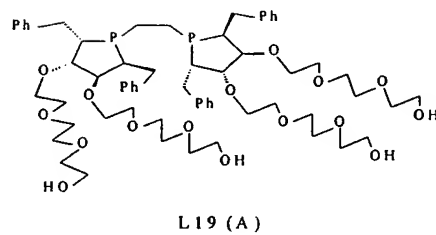
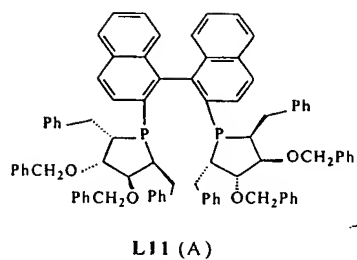
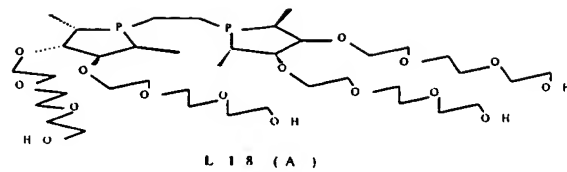
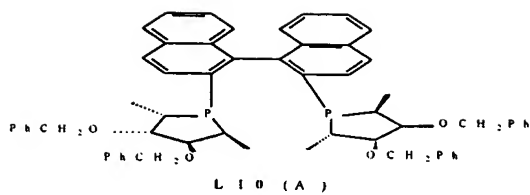
L 5 (A)

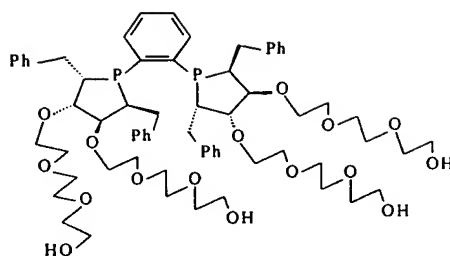


L 7 (A)



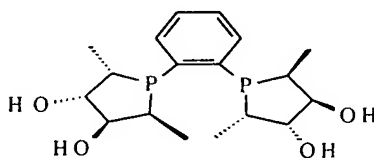
L 8 (A')





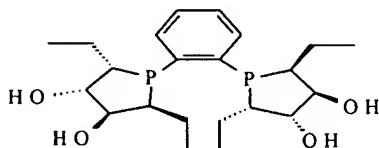
L21 (A)

5. A compound according to claim 3, of formula 2:



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6. A compound according to claim 3, of formula 3:

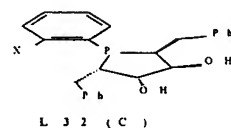
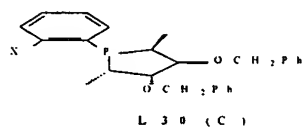
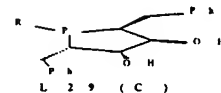
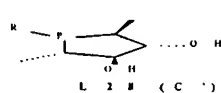


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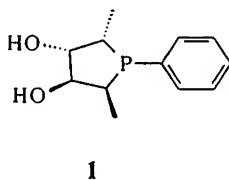
7. A compound according to claim 1, wherein the compound is of formula C or C' or the corresponding enantiomer.

8. A compound according to claim 7, wherein R is methyl, ethyl, cyclohexyl, or phenyl; R' is hydrogen or benzyl; R<sup>2</sup> is o-X-phenyl wherein X is hydrogen or a carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, diphenylphosphino, or chiral oxazolono group.

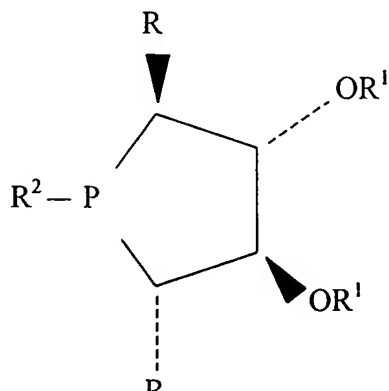
9. A compound, according to claim 1, which is selected from structures L26, L28, L29, L30 and L32, represented by the formulas:



10. A compound according to claim 1, represented by the formula (1):



11. A compound of the following formula or its corresponding enantiomer:



wherein:

- A) R is each C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> alkyl aryl; aryl C<sub>1</sub>-C<sub>8</sub> alkyl, aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, C<sub>1</sub>-C<sub>8</sub> alkylthio, thiol, dialkylamino, or diphenylphosphino, or chiral oxazoline; and
- B) R<sup>1</sup> is each H, C<sub>1</sub>-C<sub>8</sub> alkyl, silane, aryl, a water soluble unit, or a linked polymer chain or linked inorganic support; and
- C) R<sup>2</sup> is either R, H, or a symmetrical bidentate structure having the formula

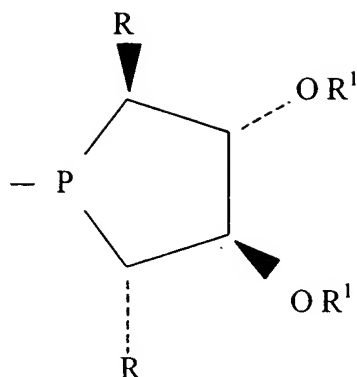


wherein  $\boxed{\text{BRIDGE}}$  is

- i)  $-(\text{CH}_2)_n-$  where n is an integer from 1 to 8; or
- ii)  $-(\text{CH}_2)_n \text{X} (\text{CH}_2)_m-$  where n and m are the same or different integers from 1 to 8, and X is O, S, NR<sup>4</sup>, PR<sup>4</sup>, AsR<sup>4</sup>, SbR<sup>4</sup>, divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where R<sup>4</sup> is C<sup>1</sup>-C<sup>8</sup> alkyl, aryl, substituted aryl, or substituted C<sub>1</sub>-C<sub>8</sub> alkyl; or
- iii) 1, 2-divalent phenyl, 2, 2'-divalent 1, 1'-biphenyl, 2,2'-divalent, 1,1' binaphthyl, or ferrocene, each of which may be substituted independently with C<sub>1</sub> - C<sub>8</sub> alkyl or aryl, F, Cl, Br, I, COOR<sup>5</sup>, SO<sub>3</sub>R<sup>5</sup>, PO<sub>3</sub>R<sup>5</sup><sub>2</sub>, OR<sup>5</sup>, SR<sup>5</sup>, NR<sup>5</sup><sub>2</sub>, PR<sup>5</sup><sub>2</sub>, AsR<sup>5</sup><sub>2</sub>, SbR<sup>5</sup><sub>2</sub>, nitro, vinyl, substituted vinyl, alkynyl wherein R<sup>5</sup> is H, C<sub>1</sub>-C<sub>8</sub> alkyl, substituted C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> fluoroalkyl, C<sub>1</sub>-C<sub>8</sub> perfluoroalkyl, aryl or substituted aryl; and

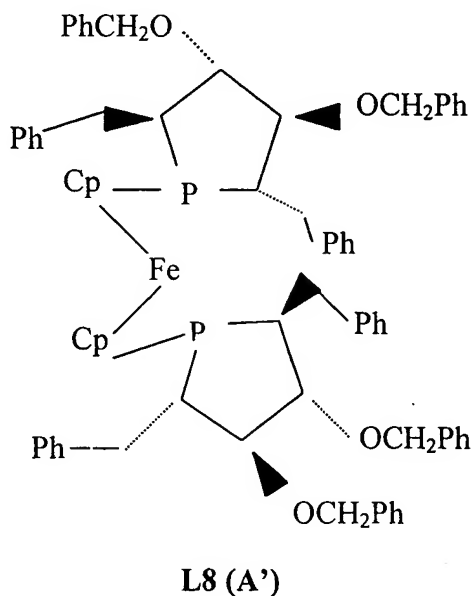
wherein Z is a compound selected from the group of compounds having the following formula and their corresponding enantiomers:

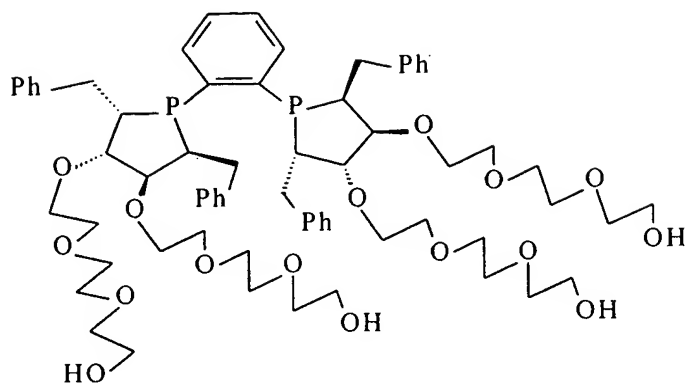




12. A compound according to claim 11 wherein R is methyl, ethyl, or benzyl; R<sup>1</sup> is hydrogen or benzyl, and BRIDGE is:  
 $-(CH_2)_n-$  where n is an integer from 1 to 3; 1,2- divalent phenyl, 2,2' divalent 1,1' biphenyl, 2,2'-divalent 1,2' binaphthyl, or ferrocene, each of which may substituted with C<sub>1</sub>-C<sub>3</sub> alkyl or OR<sup>5</sup>, wherein R<sup>5</sup> is methyl or ethyl.

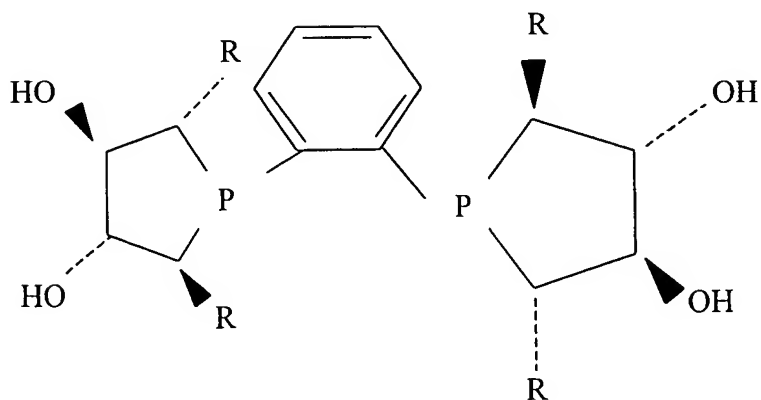
13. A compound according to claim 11 selected from the group of compounds of the following formulas and their corresponding enantiomers:



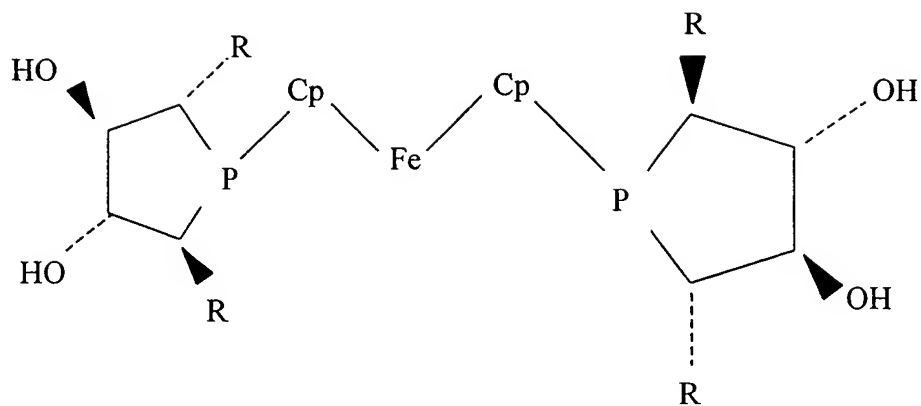


L21 (A)

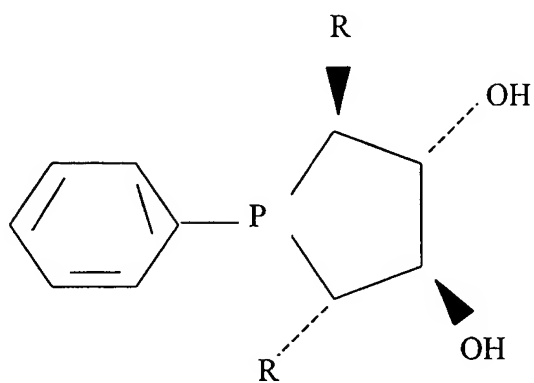
14. A compound according to claim 11 selected from the group of compounds of the following formulas and their corresponding enantiomers wherein R is either methyl or ethyl:



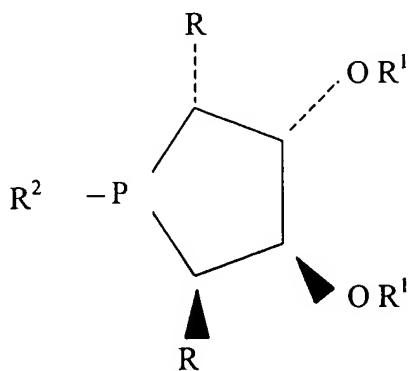
15. A compound according to claim 11 selected from the group of compounds of the following formulas and their corresponding enantiomers wherein R is either methyl or ethyl:



16. A compound according to claim 11 selected from the group of compounds of the following formula and their corresponding enantiomers:



17. A compound selected from the group of compounds of the following formula:



wherein

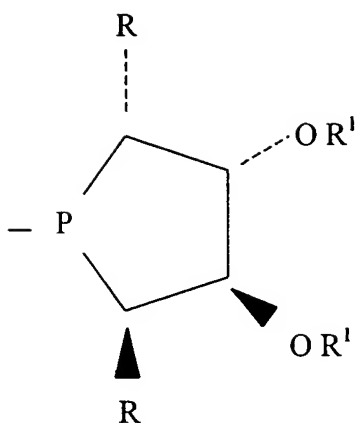
- A) R is C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> alkyl aryl, aryl C<sub>1</sub>-C<sub>8</sub> alkyl, or aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, diphenylphosphino or chiral oxazoline; and
- B) R<sup>1</sup> is H, C<sub>1</sub>-C<sub>8</sub> alkyl, silane, aryl, a water soluble unit, or a linked polymer chain, or linked inorganic support; and
- C) R<sup>2</sup> is either R, H, or a symmetrical bidentate structure having the following formula:



wherein  $\boxed{\text{BRIDGE}}$  is

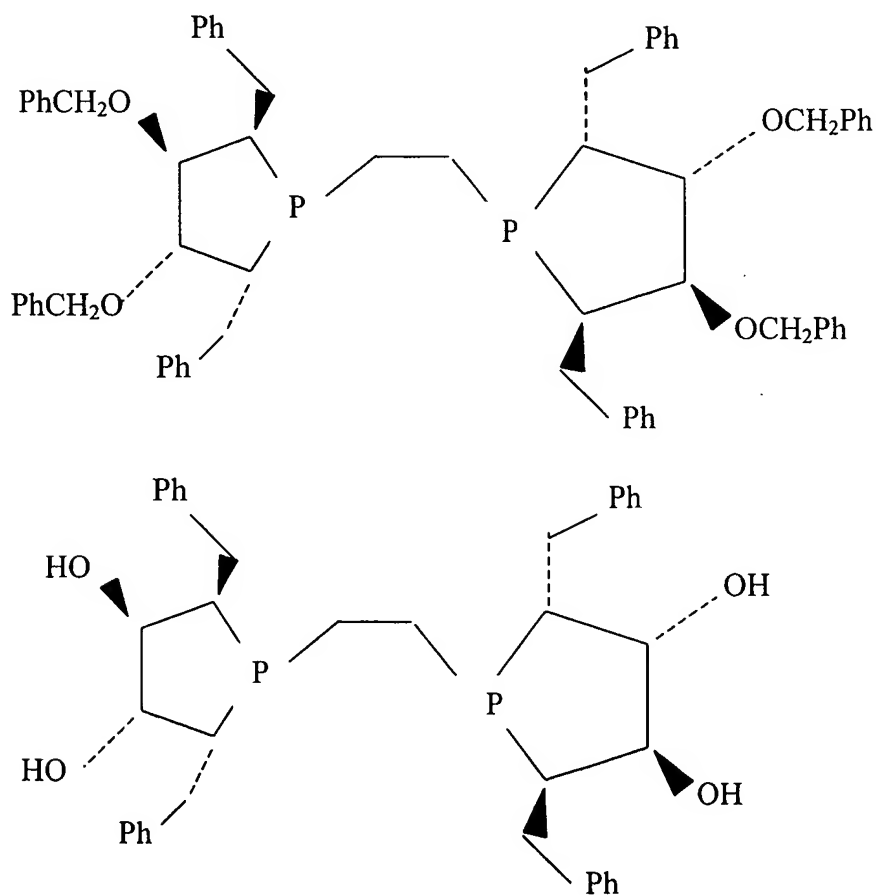
- i)  $-(\text{CH}_2)_n-$  where n is an integer from 1 to 8; or
- ii)  $-(\text{CH}_2)_n \text{X} (\text{CH}_2)_m-$  where n and m are the same or different integers from 1 to 8, and X is O, S, NR<sup>4</sup>, PR<sup>4</sup>, AsR<sup>4</sup>, SbR<sup>4</sup>, divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where R<sup>4</sup> is C<sup>1</sup>-C<sup>8</sup> alkyl, aryl, substituted aryl, or substituted alkyl; or
- iii) 1, 2-divalent phenyl, 2, 2'-divalent 1, 1'-biphenyl, 2,2'-divalent, 1,1'-binaphthyl, or ferrocene, each of which may be substituted independently with C<sub>1</sub> - C<sub>8</sub> alkyl or aryl, F, Cl, Br, I, COOR<sup>5</sup>, SO<sub>3</sub>R<sup>5</sup>, PO<sub>3</sub>R<sup>5</sup><sub>2</sub>, OR<sup>5</sup>, SR<sup>5</sup>, NR<sup>5</sup><sub>2</sub>, PR<sup>5</sup><sub>2</sub>, AsR<sup>5</sup><sub>2</sub>, SbR<sup>5</sup><sub>2</sub>, nitro, vinyl, substituted vinyl, alkynyl wherein R<sup>5</sup> is H, C<sub>1</sub>-C<sub>8</sub> alkyl, substituted C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> fluoroalkyl, C<sub>1</sub>-C<sub>8</sub> perfluoroalkyl, aryl or substituted aryl; and

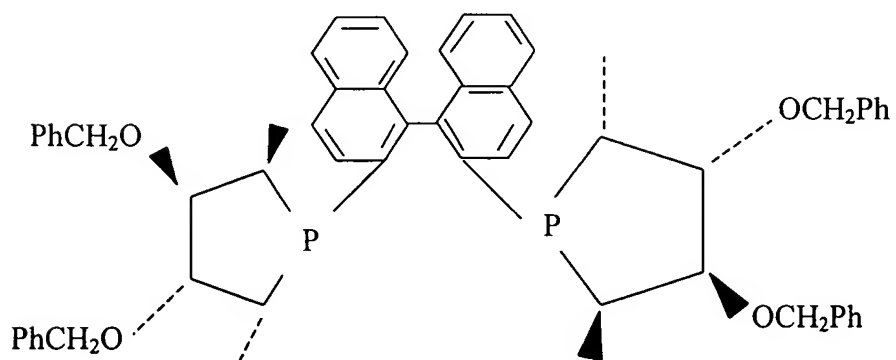
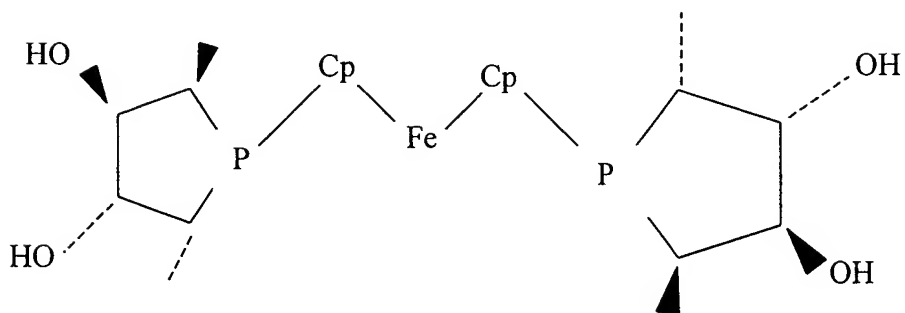
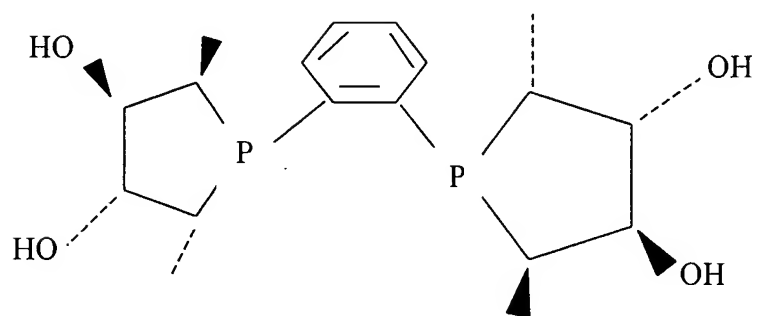
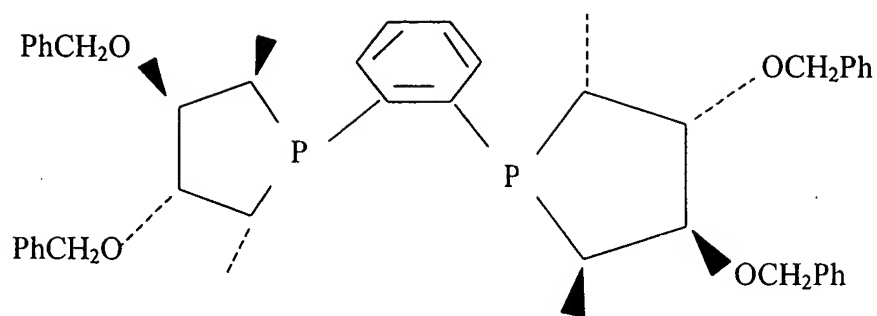
wherein Z is a compound selected from the group of compounds having the following formula:

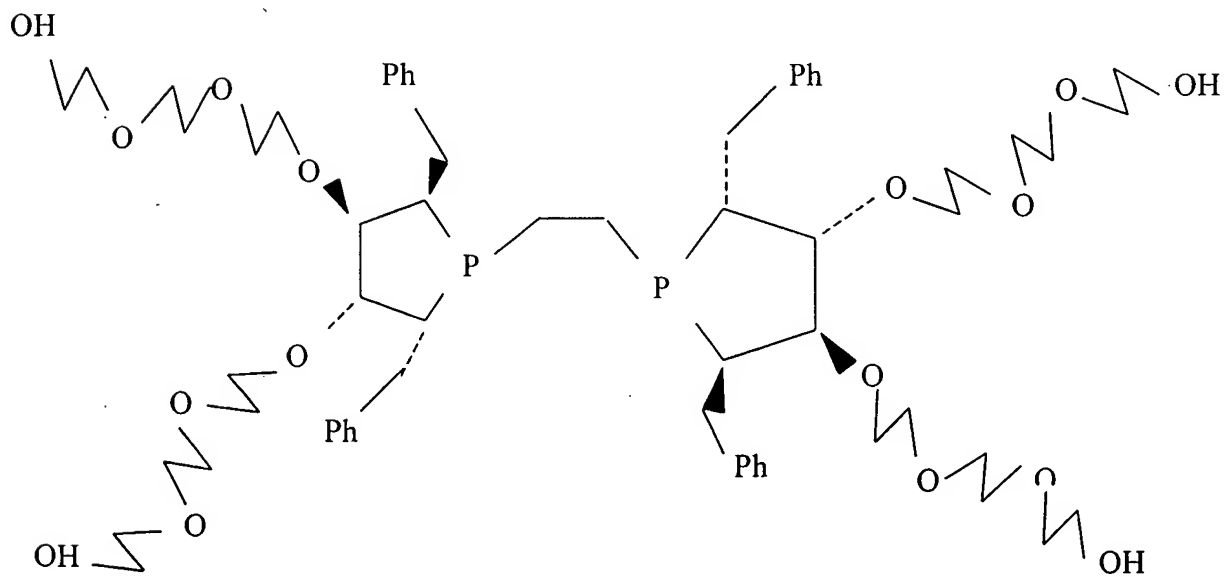
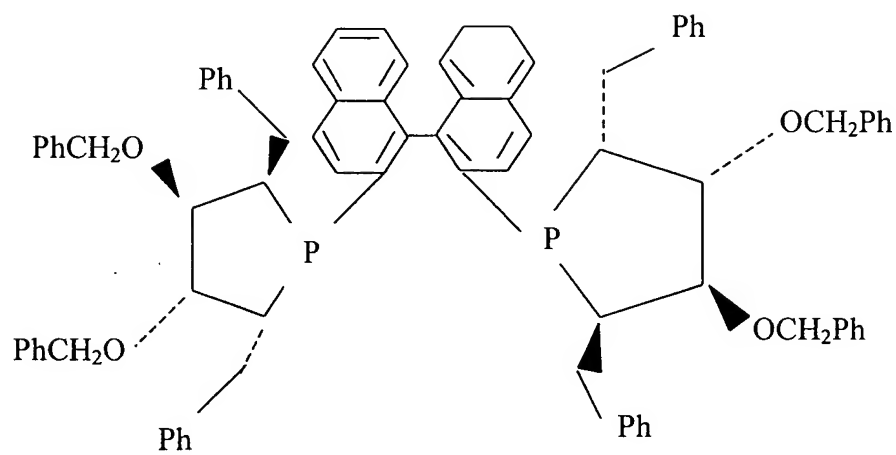
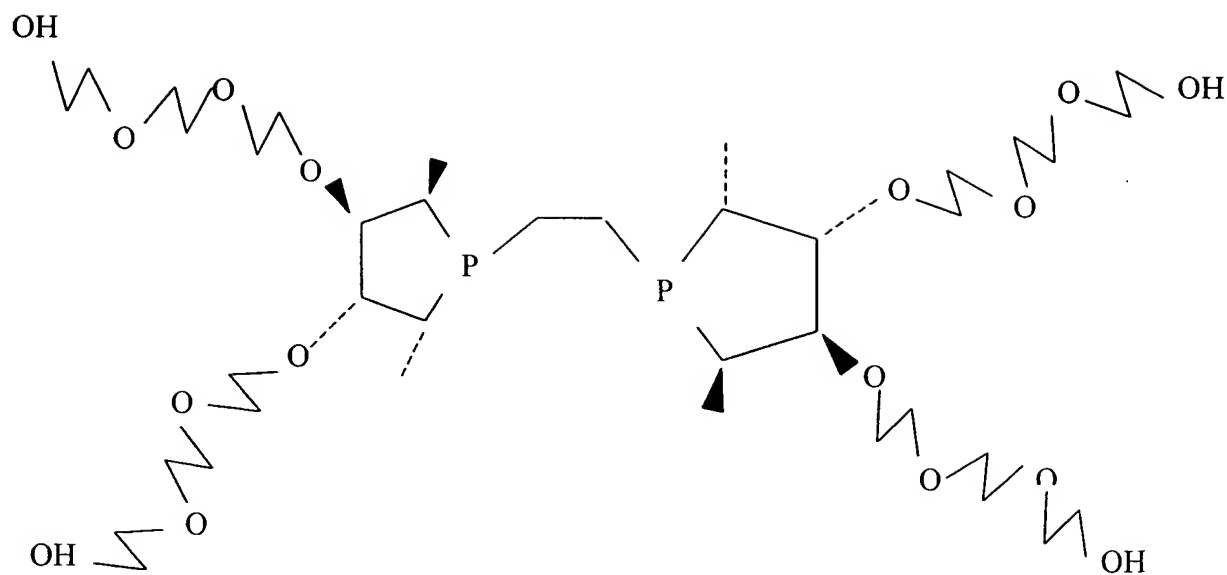


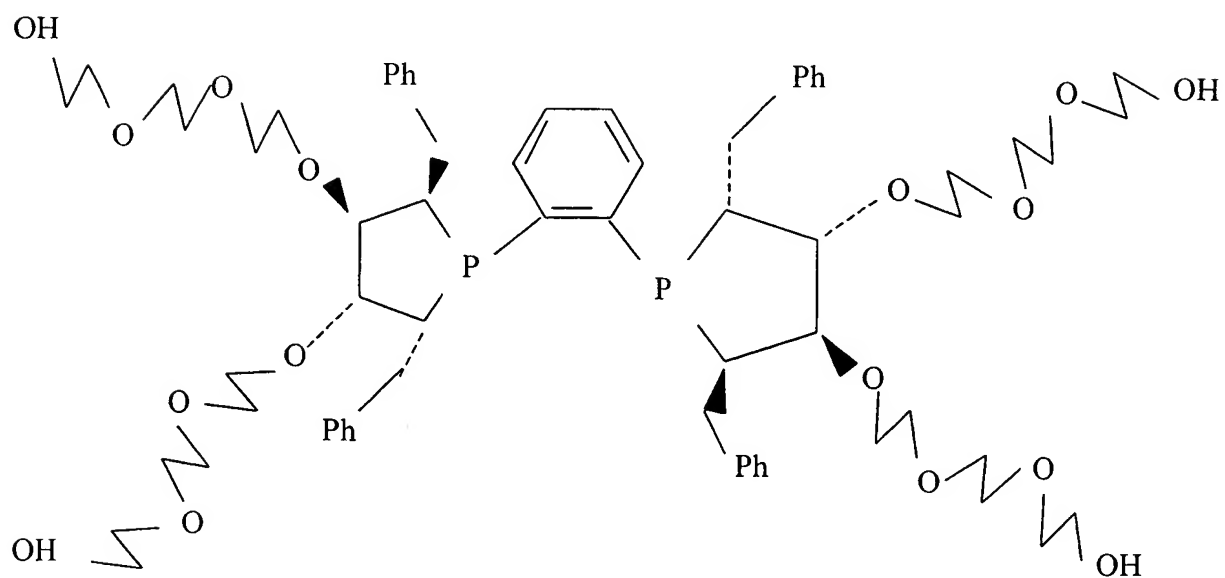
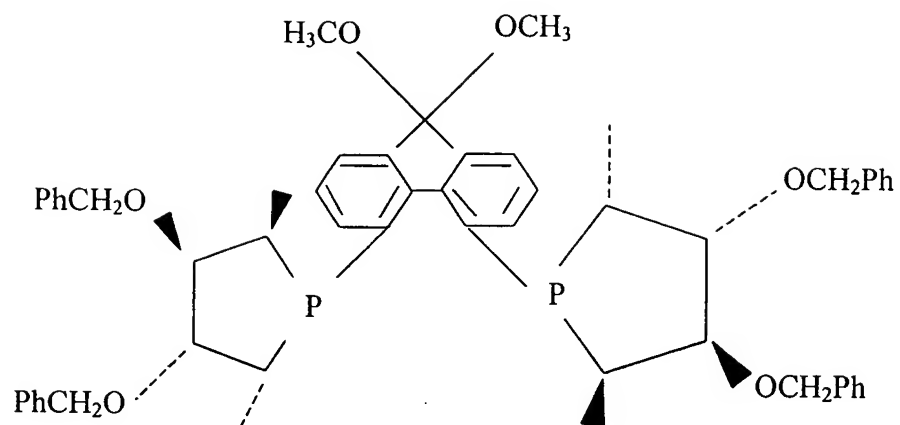
18. A compound according to claim 17 wherein R is methyl, ethyl, or benzyl; R<sup>1</sup> is hydrogen or benzyl; and the BRIDGE of R<sup>2</sup> is:-(CH<sub>2</sub>)<sub>n</sub>- where n is an integer ranging from 1 to 3; 1,2- divalent phenyl, 2,2'- divalent 1,1' biphenyl, 2,2'-divalent 1,2' binaphthyl, or ferrocene, each of which may be substituted with C<sub>1</sub>-C<sub>3</sub> alkyl or OR<sup>5</sup>, wherein R<sup>5</sup> is methyl or ethyl.

19. A compound according to claim 18 selected from the following formulas:



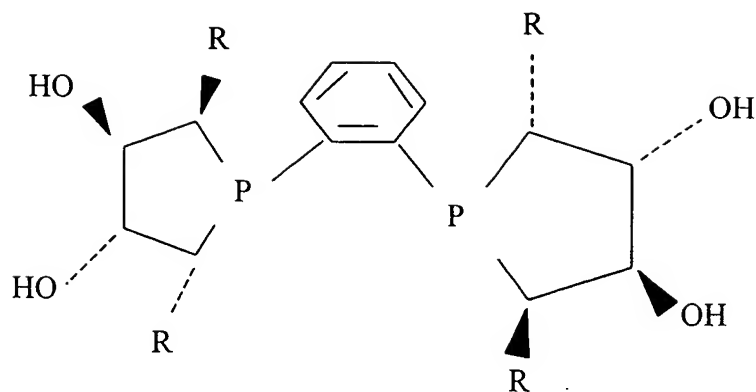




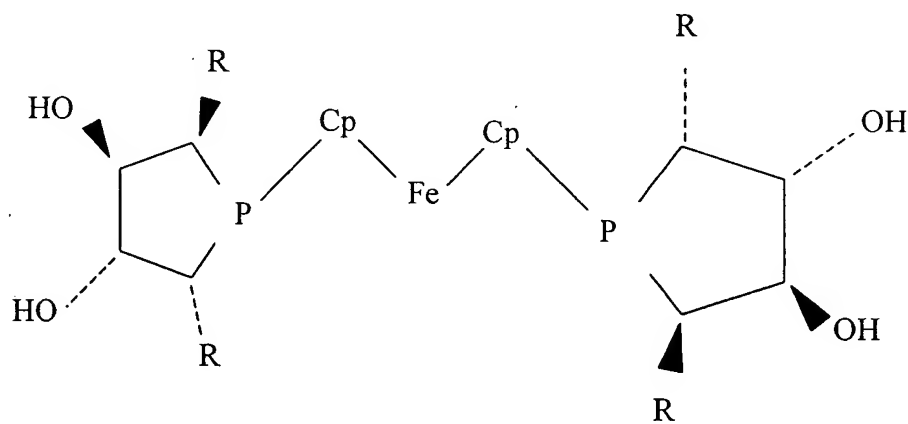


20. A compound according to claim 17 selected from the group of compounds of the following formula wherein R is methyl or ethyl:

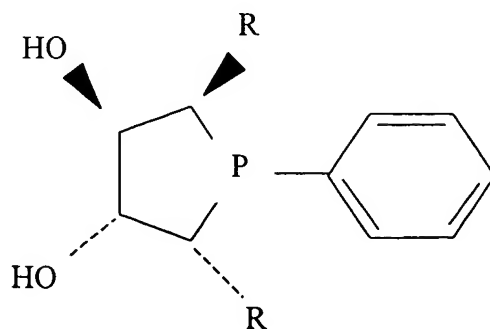




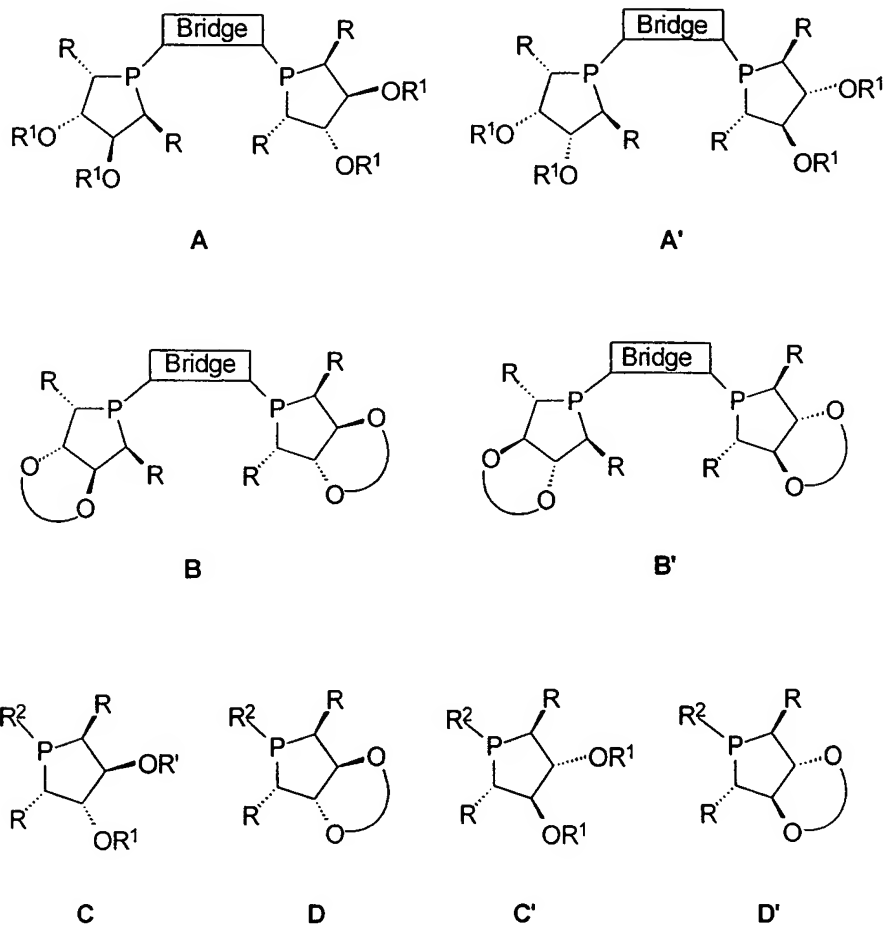
21. A compound according to claim 17 selected from the group of compounds of the following formula and their corresponding enantiomers wherein R is either methyl or ethyl:



22. A compound according to claim 17 selected from the group of compounds of the following formula wherein R is either methyl or ethyl:



23. A catalyst comprising a compound in the form of a complex with a transition metal wherein said compound is selected from compounds represented by the formula:



24. A catalyst according to claim 23, wherein the transition metal is rhodium, iridium, ruthenium, nickel, or palladium.

25. A catalyst according to claim 24, wherein said compound is a complex with a compound selected from the group consisting of:  $\text{Pd}_2(\text{DBA})_3$ ,  $\text{Pd}(\text{OAc})_2$ ;

$[\text{Rh}(\text{COD})\text{Cl}]_2$ ,  $[\text{Rh}(\text{COD})_2]\text{X}$ ,  $\text{Rh}(\text{acac})(\text{CO})_2$ ;  $\text{RuCl}_2(\text{COD})$ ,  $\text{Ru}(\text{COD})(\text{methylallyl})_2$ ,  $\text{Ru}(\text{Ar})\text{Cl}_2$ , wherein Ar is an aryl group, unsubstituted or substituted with an alkyl group;  $[\text{Ir}(\text{COD})\text{Cl}]_2$ ,  $[\text{Ir}(\text{COD})_2]\text{X}$ ; and  $\text{Ni}(\text{allyl})\text{X}$ ; wherein X is a counterion.

26. A catalyst according to claim 25, wherein X is selected from the group consisting of:  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{BF}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{SbF}_6^-$ ,  $\text{CF}_3\text{SO}_3^-$ , and  $\text{PF}_6^-$ .

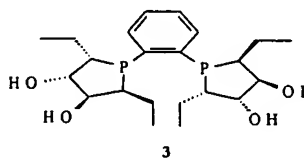
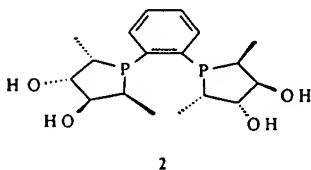
27. A catalyst according to claim 26 wherein X is  $\text{PF}_6^-$ .

28. A catalyst according to claim 24 wherein the transition metal is Ru or Rh.

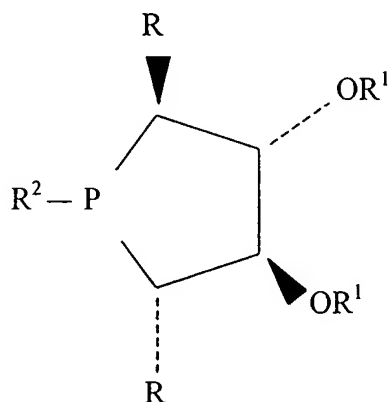
29. A catalyst according to claim 28 wherein the transition metal is Rh.

30. A catalyst according to claim 23, wherein the catalyst comprises:  $\text{Ru}(\text{RCOO})_2(\text{diphosphine})$ ,  $\text{RuX}_2(\text{diphosphine})$ ,  $\text{Ru}(\text{methylallyl})_2(\text{diphosphine})$ ,  $\text{Ru}(\text{aryl group})\text{X}_2(\text{diphosphine})$ ,  $\text{Rh}(\text{RCOO})_2(\text{diphosphine})$ ,  $\text{RhX}_2(\text{diphosphine})$ ,  $\text{Rh}(\text{methylallyl})_2(\text{diphosphine})$ , or  $\text{Rh}(\text{aryl group})\text{X}_2(\text{diphosphine})$  and X is halogen.

31. A catalyst according to claim 23 for asymmetric hydrogenation of a ketone, imine, or olefin, comprising: a complex of compounds 2 or 3 with a Rh compound selected from the group consisting of:  $[\text{Rh}(\text{COD})\text{Cl}]_2$  and  $[\text{Rh}(\text{COD})_2]\text{X}$ , wherein X is selected from the group consisting of:  $\text{BF}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{SbF}_6^-$ ,  $\text{CF}_3\text{SO}_3^-$ .



32. A catalyst according to claim 23 comprising a transition metal complex of a compound of the following formula or its enantiomer:



wherein:

(A) R is each C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> alkyl aryl; aryl C<sub>1</sub>-C<sub>8</sub> alkyl, aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, C<sub>1</sub>-C<sub>8</sub> alkylthio, thiol, dialkylamino, or diphenylphosphino, or chiral oxazoline; and

(B) R<sup>1</sup> is each H, C<sub>1</sub>-C<sub>8</sub> alkyl, silane, aryl, a water soluble unit, or a linked polymer chain or linked inorganic support; and

(C) R<sup>2</sup> is either R, H, or a symmetrical bidentate structure having the formula

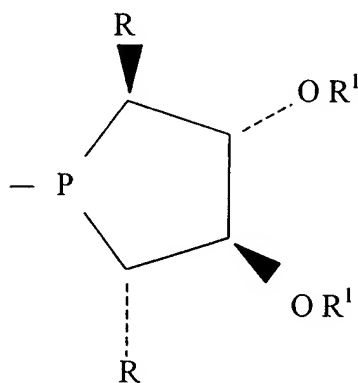


wherein  $\boxed{\text{BRIDGE}}$  is

- (i)  $-(\text{CH}_2)_n-$  where n is an integer from 1 to 8; or
- (ii)  $-(\text{CH}_2)_n \text{X} (\text{CH}_2)_m-$  where n and m are the same or different integers from 1 to 8, and X is O, S, NR<sup>4</sup>, PR<sup>4</sup>,

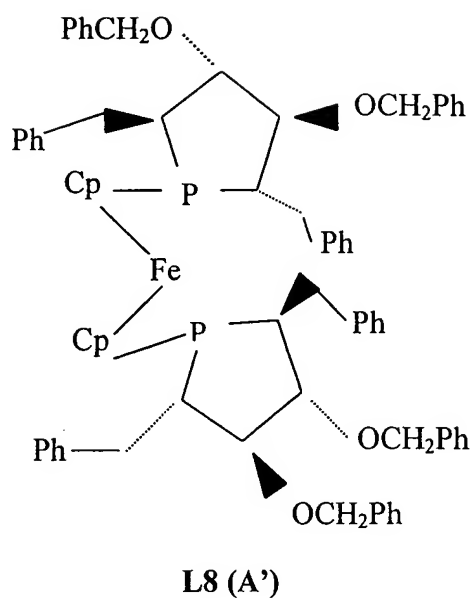
AsR<sup>4</sup>, SbR<sup>4</sup>, divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where R<sup>4</sup> is C<sup>1</sup>-C<sup>8</sup> alkyl, aryl, substituted aryl, or substituted C<sub>1</sub>-C<sub>8</sub> alkyl; or  
 (iii) 1, 2-divalent phenyl, 2, 2'-divalent 1, 1'-biphenyl, 2,2'-divalent, 1,1' binaphthyl, or ferrocene, each of which may be substituted independently with C<sub>1</sub> - C<sub>8</sub> alkyl or aryl, F, Cl, Br, I, COOR<sup>5</sup>, SO<sub>3</sub>R<sup>5</sup>, PO<sub>3</sub>R<sup>5</sup><sub>2</sub>, OR<sup>5</sup>, SR<sup>5</sup>, NR<sup>5</sup><sub>2</sub>, PR<sup>5</sup><sub>2</sub>, AsR<sup>5</sup><sub>2</sub>, SbR<sup>5</sup><sub>2</sub>, nitro, vinyl, substituted vinyl, alkynyl wherein R<sup>5</sup> is H, C<sub>1</sub>-C<sub>8</sub> alkyl, substituted C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> fluoroalkyl, C<sub>1</sub>-C<sub>8</sub> perfluoroalkyl, aryl or substituted aryl; and

wherein Z is a compound selected from the group of compounds having the following formula and their corresponding enantiomers:

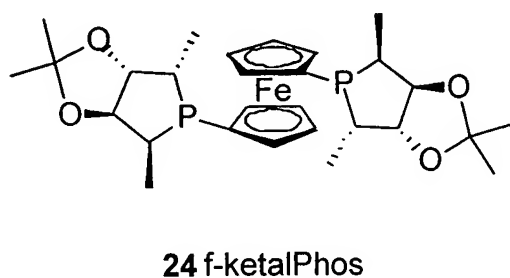


33. A catalyst according to claim 23, wherein each R<sup>1</sup> is independently selected from the group consisting of: methyl and ethyl groups.

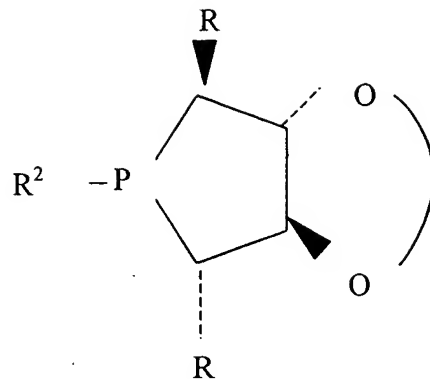
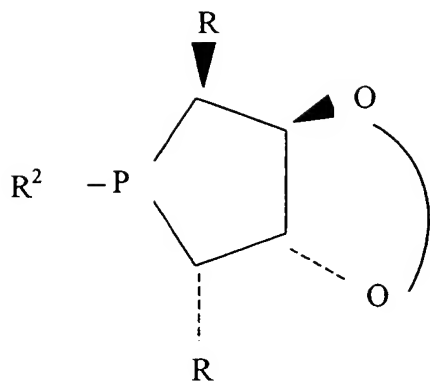
34. A catalyst according to claim 23, wherein the transition metal complex is derived from a compound of the following formula or its enantiomer:



35. A catalyst according to claim 23, wherein the transition metal complex is derived from a compound of the following formula or its enantiomer:



36. A catalyst according to claim 23 comprising a transition metal complex of a compound of the following formula or its enantiomer:



wherein

A) R is C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> alkyl aryl, aryl C<sub>1</sub>-C<sub>8</sub> alkyl, aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, diphenylphosphino or chiral oxazoline; and

B) the ring component  $\text{O} \text{---} \text{O}$  represents a protected diol, a crown ether linkage, -O-C<sub>1</sub>-C<sub>8</sub> alkyl-O- wherein the alkyl group is linked to a polymer, -O-(CH<sub>2</sub>CH<sub>2</sub>)<sub>n</sub>-O- wherein n is an integer ranging from 1 to 8 and the methylene groups are optionally substituted by C<sub>1</sub>-C<sub>8</sub> alkyl, or O-W-O, where W is BR<sup>9</sup>, POR<sup>9</sup>, PO (OR<sup>9</sup>), SO<sub>2</sub>, CO, or Si(R<sup>9</sup>)<sub>2</sub>;

where R<sup>9</sup> is C<sub>1</sub>-C<sub>8</sub> alkyl, aryl, C<sub>1</sub>-C<sub>8</sub> alkyl aryl, or aryl C<sub>1</sub>-C<sub>8</sub> alkyl, alkoxy, hydroxy, alkylthio, thio, alkylamino, dialkylamino; and

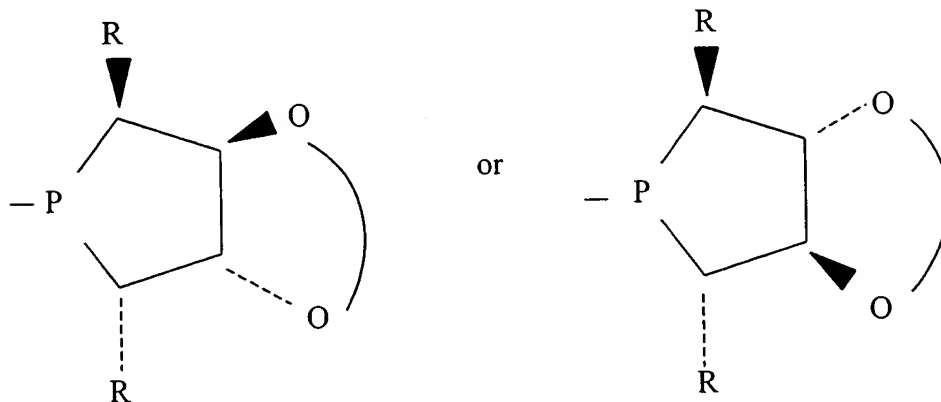
C) R<sup>2</sup> is either R, H, phenyl or a symmetrical bidentate structure having the formula



wherein  $\boxed{\text{BRIDGE}}$  is

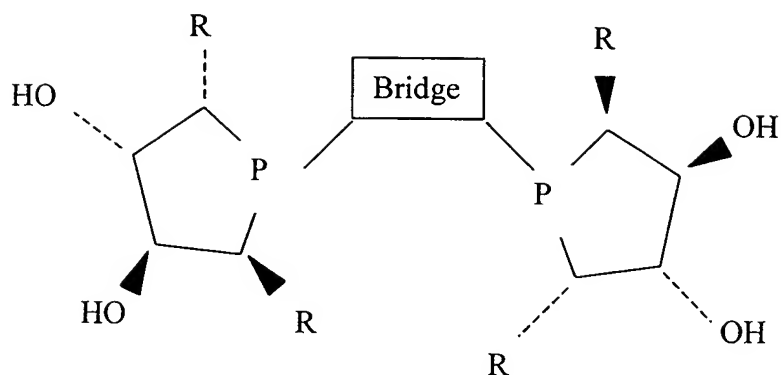
- i)  $-(CH_2)_n-$  where  $n$  is an integer from 1 to 8; or
- ii)  $-(CH_2)_n X (CH_2)_m-$  where  $n$  and  $m$  are the same or different integers from 1 to 8, and  $X$  is O, S,  $NR^4$ ,  $PR^4$ ,  $AsR^4$ ,  $SbR^4$ , divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where  $R^4$  is  $C^1$ - $C^8$  alkyl, aryl, substituted aryl, or substituted alkyl; or
- iii) 1, 2-divalent phenyl, 2, 2'-divalent 1, 1'-biphenyl, 2,2'-divalent, 1,1' binaphthyl, or ferrocene, each of which may be substituted independently with  $C_1 - C_8$  alkyl or aryl, F, Cl, Br, I,  $COOR^5$ ,  $SO_3R^5$ ,  $PO_3R^5_2$ ,  $OR^5$ ,  $SR^5$ ,  $NR^5_2$ ,  $PR^5_2$ ,  $AsR^5_2$ ,  $SbR^5_2$ , nitro, vinyl, substituted vinyl, alkynyl wherein  $R^5$  is H,  $C_1$ - $C_8$  alkyl, substituted  $C_1$ - $C_8$  alkyl,  $C_1$ - $C_8$  fluoroalkyl,  $C_1$ - $C_8$  perfluoroalkyl, aryl or substituted aryl; and

wherein Z is a compound selected from the group of compounds having the following formulas and their corresponding enantiomers:



37. A process for preparing a compound of formula A, represented by the formula:

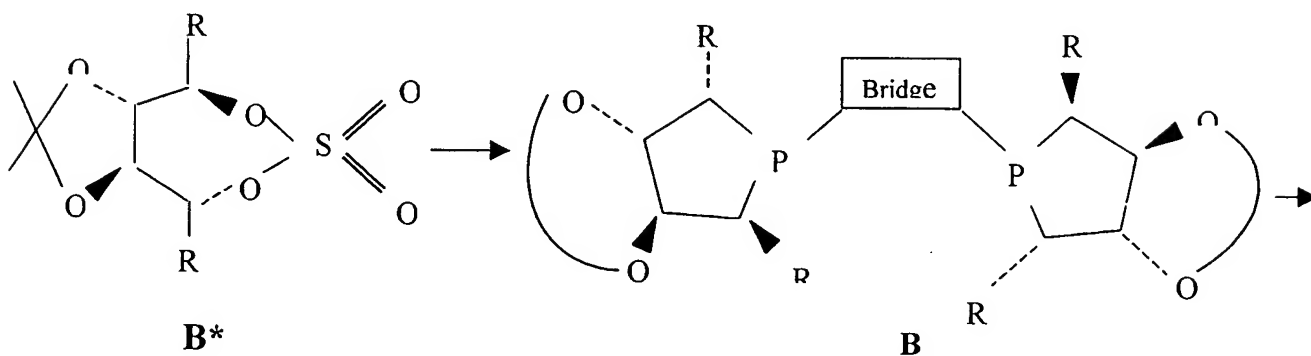




A

said process comprising:

reacting a compound of formula B\* with a phosphine to form compound B:



and thereafter

reacting compound B with an acid to form compound A;

wherein the phosphine is  $\text{H}_2\text{P} \left\{ \text{Bridge} \right\} \text{-PH}_2$ ;

A) R is aryl,  $\text{C}_1\text{-C}_8$  alkyl,  $\text{C}_1\text{-C}_8$  alkyl aryl, or aryl  $\text{C}_1\text{-C}_8$  alkyl, which may be substituted with carboxylic acid, alkoxy, hydroxy,  $\text{C}_1\text{-C}_8$  alkylthio, thiol, dialkylamino, diphenylphosphino, or chiral oxazolino groups;

B) the ring component  $\text{O O}$  represents a protected diol, a crown ether linkage, or

-O-(CH<sub>2</sub>CH<sub>2</sub>)<sub>n</sub>-O- wherein n is an integer ranging from 1 to 8 and the methylene groups are optionally substituted by alkyl or linked to a polymer; and

C) Bridge may be:

-(CH<sub>2</sub>)<sub>n</sub>- where n is an integer ranging from 1 to 8;

-(CH<sub>2</sub>)<sub>n</sub>-X-(CH<sub>2</sub>)<sub>m</sub>- wherein n, m are each integers, the same or different, ranging from 1 to 8; or

1,2-divalent phenyl, 2,2'-divalent 1,1' biphenyl or 2,2'-divalent 1,2'binaphthyl or ferrocene, each of which may be substituted with aryl or substituted aryl, or alkyl having 1-8 carbon atoms, heteroatom groups such as F, Cl, Br, I, COOR<sup>5</sup>, SO<sub>3</sub>R<sup>5</sup>, PO<sub>3</sub>R<sup>5</sup><sub>2</sub>, OR<sup>5</sup>, SR<sup>5</sup>, NR<sup>5</sup><sub>2</sub>, PR<sup>5</sup><sub>2</sub>, AsR<sup>5</sup><sub>2</sub>, or SbR<sup>5</sup><sub>2</sub>,

wherein the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, C<sub>1</sub>-C<sub>8</sub> alkyl, alkoxyl, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acids; and R<sup>5</sup> is hydrogen, C<sub>1</sub>-C<sub>8</sub> alkyl, C<sub>1</sub>-C<sub>8</sub> fluoroalkyl, or C<sub>1</sub>-C<sub>8</sub> perfluoro, aryl; substituted aryl; aryl C<sub>1</sub>-C<sub>8</sub> alkyl; ring-substituted arylalkyl; or CR<sup>3</sup><sub>2</sub>(CR<sup>3</sup><sub>2</sub>)<sub>q</sub>X(CR<sup>3</sup><sub>2</sub>)<sub>p</sub>R<sup>1</sup> wherein q and p are integers, the same or different, ranging from 1 to 8; X is O, S, NR<sup>4</sup>, PR<sup>4</sup>, AsR<sup>4</sup>, SbR<sup>4</sup>, divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein R<sup>3</sup> and R<sup>4</sup> are aryl, C<sub>1</sub>-C<sub>8</sub> alkyl, substituted aryl and substituted alkyl groups.

38. A process according to claim 37 wherein:

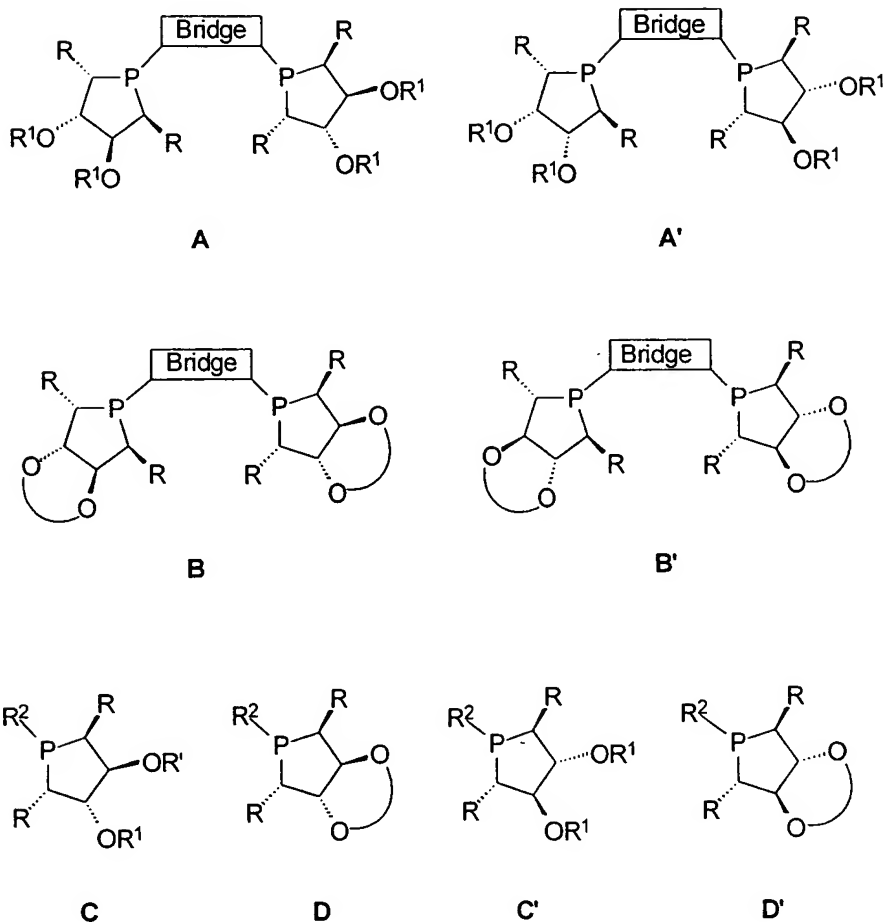
R is C<sub>1</sub>-C<sub>4</sub> alkyl;

the ring component  $\widehat{\text{O O}}$  represents a protected diol; and Bridge is unsubstituted or substituted 1,2-divalent phenyl.

39. A process according to claim 38 wherein R is methyl or ethyl, the ring component  $\widehat{\text{O O}}$  is -O-C(CH<sub>3</sub>)<sub>2</sub>-O- and Bridge is unsubstituted 1,2-divalent phenyl.

40. A process comprising subjecting a substrate to an asymmetric reaction in the presence of a catalyst comprising a chiral ligand represented by the formula A,

A', B, B', C, C', D, or D', or the corresponding enantiomer:



wherein:

- R and R<sup>2</sup> are independently aryl, alkyl, alkyl aryl, aryl alkyl, or chiral oxazolono which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, or diphenylphosphino groups;
- R<sup>1</sup> can be H, alkyl, silane, aryl, a water soluble unit, or a linked polymer chain or inorganic support;
- the ring component O O represents a protected diol, a crown ether linkage, -O-alkyl-O- wherein the alkyl group is linked to a polymer, or -O-(CH<sub>2</sub>CH<sub>2</sub>-O)<sub>n</sub>- wherein n is an integer ranging from 1 to 8 and the methylene groups are optionally substituted by C1-C8 alkyl; and

d) Bridge may be:

$-(CH_2)_n-$  where n is an integer ranging from 1 to 8;

$-(CH_2)_nX(CH_2)_m-$  wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S,  $NR^4$ ,  $PR^4$ ,  $AsR^4$ ,  $SbR^4$ , divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein  $R^4$  is aryl, alkyl, substituted aryl, or substituted alkyl; or 1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I,  $COOR^5$ ,  $SO_3R^5$ ,  $PO_3R^5$ ,  $OR^5$ ,  $SR^5$ ,  $NR^5_2$ ,  $PR^5_2$ ,  $AsR^5_2$ , or  $SbR^5_2$ , wherein:

the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, alkyl, alkoxyl, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acids; and

$R^5$  is hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, or C1-C8 perfluoroalkyl, aryl; substituted aryl; arylalkyl; ring-substituted arylalkyl; or  $-CR^3_2(CR^3_2)_qX(CR^3_2)_pR^1$  wherein q and p are integers, the same or different, ranging from 1 to 8;  $R^3$  is aryl, alkyl, substituted aryl, or substituted alkyl; and X is as defined above;

wherein said asymmetric reaction is a hydrogenation, hydride transfer, hydrosilylation, hydroboration, hydrovinylation, olefin metathesis, hydroformylation, hydrocarboxylation, allylic alkylation, cyclopropanation, Diels-Alder, Aldol, Heck [m + n] cycloaddition, or Michael addition reaction.

41. A process according to claim 40, wherein said asymmetric reaction comprises asymmetric hydrogenation of a ketone, imine, enamide, or olefin.

42. A process according to claim 40, wherein said asymmetric reaction comprises Rh(I)-catalyzed hydrogenation of a dehydroamino acid or an ester thereof.